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# RESPONSIVE HYBRID HYDROGEL NANOSTRUCTURES FOR BIOMEDICAL APPLICATIONS

Nestor Gisbert Quilis – Valladolid 13-16/12/2015



# Outline

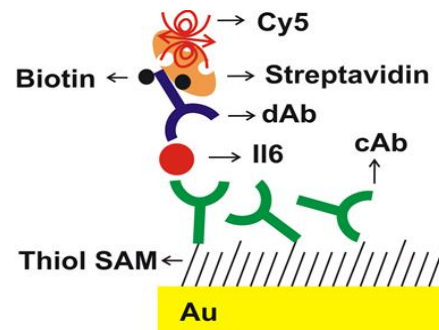
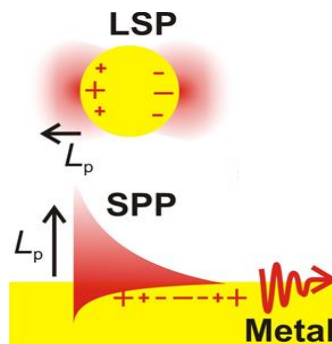
- ➔ Plasmonic Biosensor with Hydrogel Binding Matrix
- ➔ Goals
- ➔ Preparation of Metallic-Hydrogel Nanostructures
- ➔ Secondments
- ➔ Deliverables

# Plasmonic Biosensor

**Surface plasmons (SPs):** collective electron oscillations at the interface between metal and dielectric

SPs allows for tight confinement of electromagnetic field at the interface

SPs can be used to probe analytes and their interactions

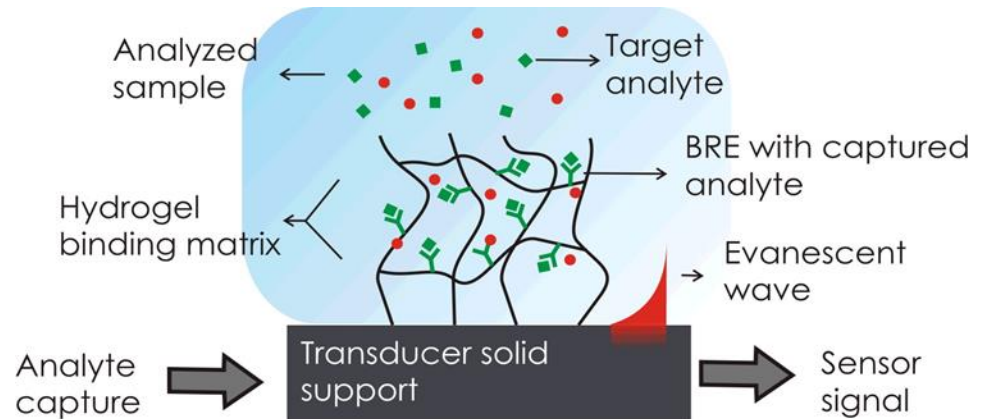


Extreme signal amplification at plasmonic “hot spots”

Different readouts: SPR, SERS, SEIRA, PEF

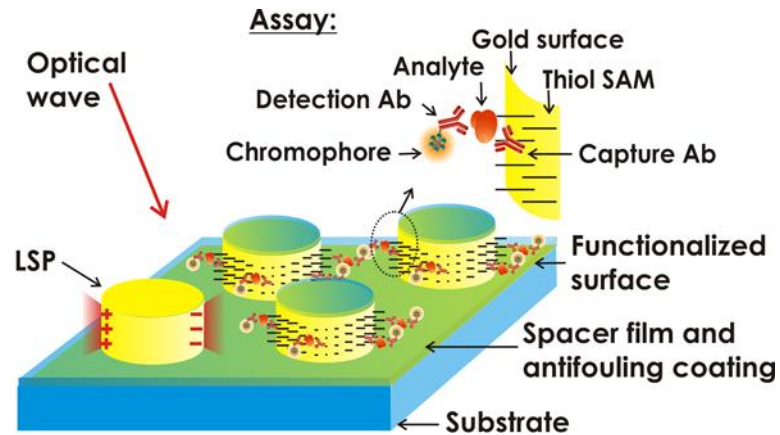
# Hydrogel Binding Matrix

- Photocrosslinkable (benzophenone groups)
- Enables post modification ( -COOH chemistry)
- Anti-fouling properties
- Thermoresponsiveness (LCST polymer)
- Large binding capacity (3D architecture)



# Goals

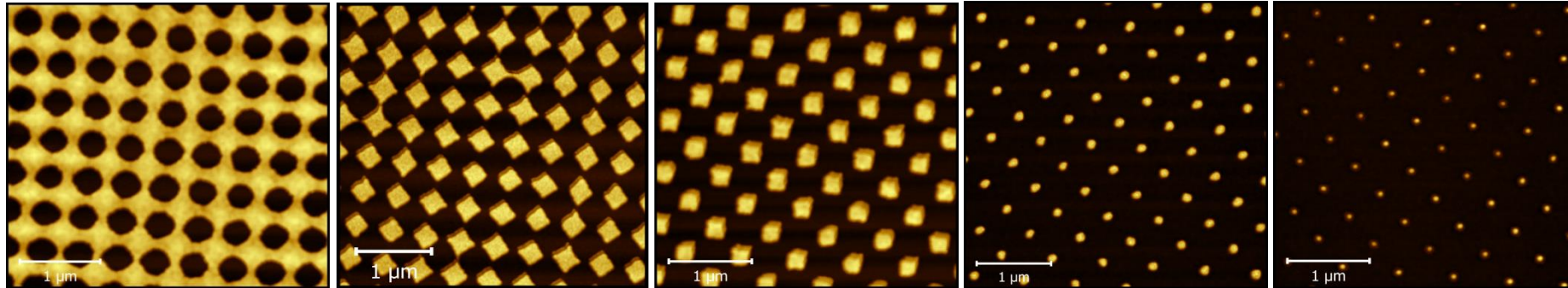
## Hybrid nanostructure supporting LSPs



Platform for ultrasensitive detection using plasmon enhanced fluorescence and responsive hydrogels

# Fabrication of Nanostructures with LIL

Diameter can be tuned between 400 – 100 nm

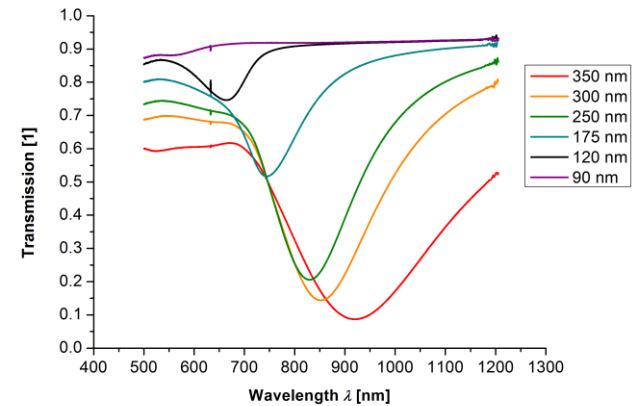
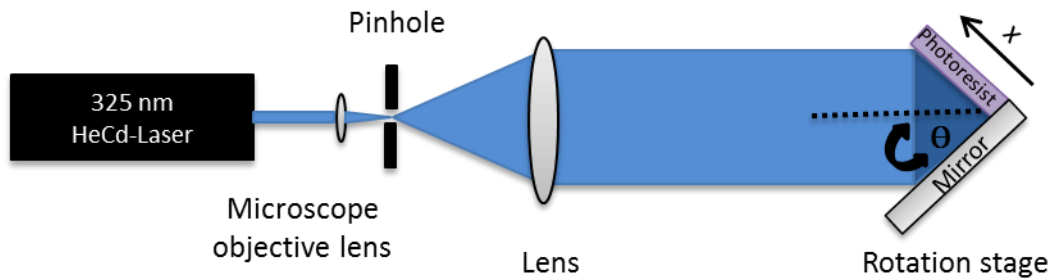


AFM Images

$\lambda \sim 460 \text{ nm}$

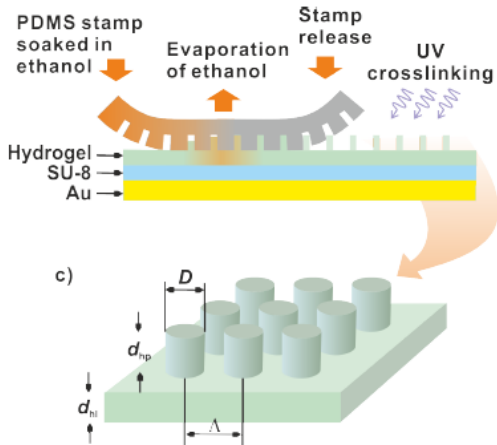
Height  $\sim 50 \text{ nm}$

## Laser Interference Lithography (LIL)

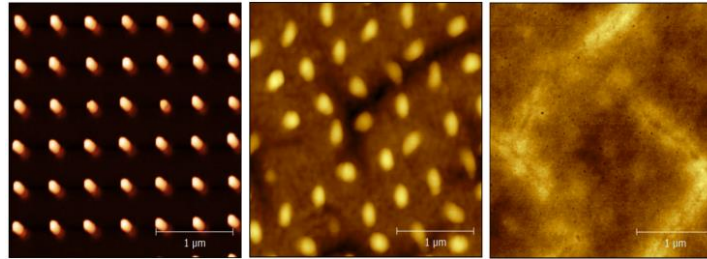


# Preparation of Hydrogel Structures with NIL and LIL

## Nanoimprinting Lithography (LIL)



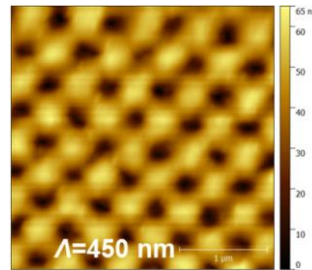
Nityanand Sharma



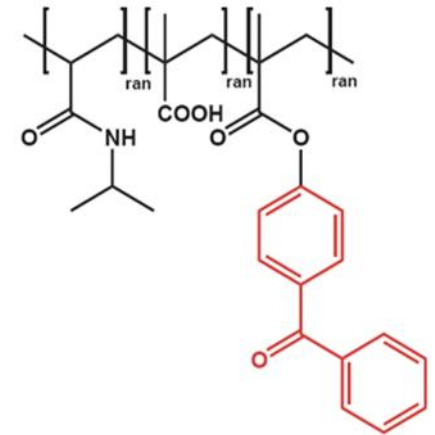
$T > 32\text{ }^{\circ}\text{C}$   
Collapsed

$T < 32\text{ }^{\circ}\text{C}$   
Swollen

## Laser Interference Lithography (LIL)



NIPAAm-based hydrogel



Prof. Jonas Group



➤ Application cell culture / drug delivery

# Secondments

Use thermoresponsive pNIPAAm nanopillars for cell culture and/or drug delivery

Biocoatings could be added to increase responsiveness by chemical functionalization of COOH moieties or physical adsorption

**DWI** Leibniz-Institut  
für Interaktive Materialien



# Deliverables

Optical characterization methods - characterization of thin film hydrogels by optical waveguide spectroscopy (OWS) and surface plasmon resonance (SPR)

Swelling ratio, thickness..

Imaging (SEM, AFM)

Preparation of nanostructures

Rapid and ultrasensitive biosensor to detect biomarkers

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Thank you for your attention !